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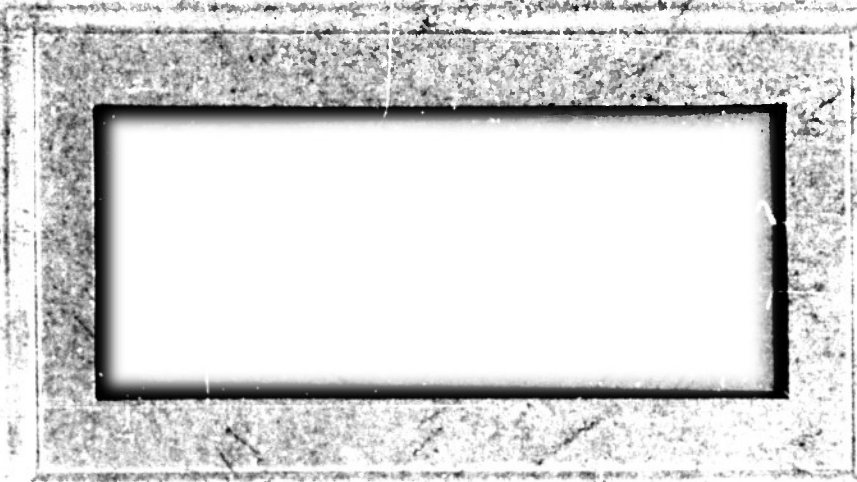
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Engineering Report
No. 132-24

Copy No. 6

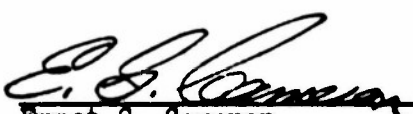
V-52 KLYSTRON OSCILLATOR
REFINEMENT AND PRODUCTION PROGRAM

Progress Report for
June 1954

Prepared for: Bureau of Ships
Navy Department

On: BuShips Contract No. NObS-5358

By: Claude Conner and David Clifford

Approved: 
Emmet G. Cameron
Chief Product Engineer

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PURPOSE

The purpose of the program covered by BuShips Contract No. NObs-5358 is to refine and produce one thousand (1000) rugged X-band local oscillator V-52 klystrons. This tube is to comply with the specifications of SHIPS E-720, which were subsequently modified at a conference held at the Bureau of Ordnance, Washington, D.C. on 20-21 May 1952 and later at a conference held at Varian Associates on 29-30 September 1952.

PROGRESS

In last month's report¹ it was pointed out that a higher pretune frequency and the use of invar tuning screws were to be established. Screws made of the new material have been ordered but to date none have been received. However, the pretune frequency has been changed, which alone may improve the frequency drift results.

Since the establishment of control of the "post length" in the internal cavity, a considerable decrease in the spread of "initial frequencies" at pretune has resulted, which should be reflected by more uniform test results. A statistical analysis has revealed that 98 per cent of the tubes produced now have an initial frequency spread of less than five per cent of the operating frequency, whereas previously the spread had been as high as 16 per cent².

Very little progress has been made in the tests of the effect on thermal compensation of thin cavity headers in the drift tube assemblies. A group of 12 special parts were inserted in assemblies, but all assemblies were accidentally damaged. An attempt is now being made to salvage the special parts in order to rerun them.

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1 Varian Engineering Report No. 132-23

2 Varian Engineering Report No. 132-20

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Sufficient test information was obtained to determine if the proposed change of loading slug material and shape would be a profitable one. The tests revealed that the thermal compensation would not be abnormally affected. (Computations based upon empirical determinations indicate that the use of steel should attain approximately 0.3 mc compensation - a number small enough to be masked by other variables but, nevertheless, in the desired direction.) In addition, the use of the modified loading slug will enable simplified and improved processing, which should result in greater productivity through increased yield. Engineering orders are now being written to cover the changes in material and techniques.

About the middle of this month final testing was started using the new V-52-1A specifications. The tubes involved utilize the right-angle reflector-lead molding and the new external cavities which provide insulated tuning screws and require no separate locking operation. Manufacturing drawings describing the tube and external cavity (and the various subassemblies) are nearing completion and the new operation schedules are being compiled. Early next month drawings are to be made which will describe the proposed castings of the external cavity.

Excessive mode interference has occurred in a small percentage of tubes as a result of the new test specifications (V-52-1A). Since the tubes are not loaded as heavily as under the previous V-52 specifications, it is believed that the spurious modes are capable of being excited over a wider tuning range, thus enabling the mode suppressor screws to be less effective. Methods of eliminating this undesirable feature will be investigated, so as to prevent re-occurrence of this trouble in all future tubes.

Experiments are continuing with regard to changes in warm-up drift measurements which occur following the silastic molding operation. So far it is apparent that a considerable number of tubes must be made utilizing the thicker reflector stem cup in order to achieve proper evaluation. The procedure has been delayed considerably recently due to the excessive time involved in testing tubes against the new specifications (about 7.5 hours

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per tube). However, it is believed that this delay can be eliminated fairly soon since greater familiarity with the new specifications will allow institution of sampling procedures to replace the 100 per cent testing now being done.

Continued emission trouble is being experienced. Attention is being focused on cathode handling and processing techniques, specifically with regard to the cobalt plating and firing/brazing operations. There is considerable evidence that this plating is somehow contributing to the poor emission picture.

Performance data of tubes tested in the month of May and the first two weeks of June are given in Tables I and II, respectively. Production data for tubes in process in June are given in Table III.

TABLE I
AVERAGE PERFORMANCE DATA OF TUBES TESTED
DURING MAY
(First Test)

	<u>Beam Voltage = 300 v</u>	
Frequency (mc)	8800	9600
Beam Current (ma)	40.39 (122)	40.28 (121)
Reflector Voltage (v)	-64.68 (122)	-93.12 (121)
Power Output (mw)	52.23 (122)	69.36 (121)
Bandwidth (mc)	74.51 (122)	52.93 (121)
Mod. Sens. (mc/v)	3.78 (121)	2.59 (121)
Drift, 10 minutes (mc)	-3.11 (54)	-3.02 (113)

35 per cent of 60 tubes tested were within the 3-mc drift requirement at both ends of the tuning range. Seventeen of these tubes were tested with invar tuning screws.

The number in parenthesis indicates the number of tubes tested.

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TABLE II

AVERAGE PERFORMANCE DATA OF TUBES TESTED
IN THE FIRST TWO WEEKS OF JUNE
(First Test)

Beam Voltage = 300 v

Frequency (mc)	8300	9600
Beam Current (ma)	40.34 (86)	40.27 (85)
Reflector Voltage (v)	-65.50 (86)	-94.98 (85)
Power Output (mw)	50.90 (86)	69.00 (85)
Bandwidth (mc)	68.57 (86)	52.24 (85)
Mod. Sens. (mc/v)	3.53 (86)	2.54 (85)
Drift, 10 minutes (mc)	-3.49 (13)	-3.42 (79)

25 per cent of 16 tubes tested were within the 3-mc drift requirements at both ends of the tuning range.

The number in parenthesis indicates the number of tubes tested.

TABLE III

PRODUCTION DATA - TUBES IN PROCESS IN JUNE

<u>Work Station</u>	<u>Number of Tubes Submitted</u>	<u>Yield</u>
Body Assembly	158	97%
Pretune	153	100%
Seal In	141	99%
Exhaust	91	100%
Aging	135	100%
First Test	176	93%
Molding	133	96%
First Finish	188	99%

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TABLE III (Continued)

PRODUCTION DATA - TUBES IN PROCESS IN JUNE

<u>Work Station</u>	<u>Number of Tubes Submitted</u>	<u>Yield</u>
Second Test	152	99%
Second Finish	43	100%
Final Test	43	93%
Final Inspection	36	<u>100%</u>
		78% Compounded - All Stations

During the month of June, design was completed on the semi-automatic grid cut-off lathe, which is part of Item 15 of the facilities contract (NObs-3227). Approval was received for the purchase of this item and the order was placed. Delivery is expected in two or three months.

Also ordered in June were four light-duty welder heads, Item 12, and two welder power supplies and two medium-duty Taylor Winfield welding heads on Item 13. These welder heads are needed to evaluate the use of certain types of welding points.

PROGRAM FOR NEXT INTERVAL

Tests of the thin cavity headers in the drift tube and their effect on thermal compensation will be continued.

Final testing of the V-52 tubes will continue. The manufacturing drawings and the new operation schedules will be completed.

Methods of eliminating the excessive mode interference occurring in tubes checked against the new test specifications will be investigated.

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Experiments with regard to changes in warm-up drift measurements which occur following the silastic molding operation will continue.

Study of the emission problem will be carried on.

Estimated expenditures during June 1954: \$31,916.00

Estimated man-hours during June 1954: 3,154

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